

# Ferns of Dharamsala Hills<sup>1</sup>

Ophioglossaceous, Schizaeaceous and Hymenophyllaceous series

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(With twenty-one text-figures)

This study deals with 21 species of ferns of Dharamsala hills. All important morphological characters on which the classification is based namely type of rhizome, dermal appendages on rhizome, stipe, rachis, rachilets or costules (when present), lamina, venation, soral position, industrial architecture (if present) and sporangial organisation are described and illustrated. Keys to genera and species have been prepared.

Beddome (1863, 1883 & 1892), Clarke (1880) and Hope (1899-1904) presented good taxonomic accounts of Indian ferns. Regional catalogues of ferns pertaining to particular places in the North Western Himalayas have been given by Hope (*vide* Collett, 1921), Blanford (1888) and Bir (1963) from Simla hills ; Marten (1909), Mehra (1939) and Stewart (1942) from Mussoorie hills ; Stewart (1945, 51) from Kashmir and Pahlgam ; Loyal & Verma (1960) from Nainital ; Mehra & Dhir (1968) from Dalhousie hills and Dhir & Sheera (in press) from Dharamsala hills. Recently, good taxonomic accounts of a few families namely Athyriaceae, Aspleniaceae, Blechnaceae, Loxogrammeaceae and Polypodiaceae of Simla ferns were given by Bir & Shukla (1966, 1968 & 1971). Bir & Trikha (1968, 1969 & 1974) have revised the taxonomy of a few Polypodiaceous taxa like *Microsorium*, *Polypodium lineare* complex and *Lepisorus excavatus* group. But none of the authors since Hope (l.c.) have attempted a taxonomic revision of all the ferns of one area. An area-wise key to the plants is a general necessity for easy recognition of different fern genera and species.

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This study was carried out on 21 species of ferns belonging to 11 genera and 10 families. Every aspect of external morphology has been studied in great detail and keys to the genera and species are given. Voucher specimens are deposited in the Panjab University herbarium (PAN). Mehra (1961) has been followed for the arrangement of families and genera.

## OPHIOGLOSSACEOUS SERIES

### Family OPHIOGLOSSACEAE

Terrestrial herbs ; rhizome short, fleshy, not scaly ; fronds solitary or few, straight (not circinate) in venation ; sporangia embedded in or seated upon a stalked spike, sporangial walls more than one cell in thickness and annulus absent.

### *Ophioglossum* Linn.

Sterile blade simple, entire ; veins anastomosing ; spike arises from the centre of the barren segment bearing two rows of sporangia which are joined together almost completely, each opening by a transverse slit.

The genus is world wide in distribution. Clausen (1938) has recognised only 38 species

whereas some authors split it into 56 species. One species is recorded here.

*O. vulgatum* Linn., Sp. Pl, 2, 1062, 1753 ; Clarke Trans. Linn. Soc. Lond. II, Bot., 1, 586, 1880.

Rhizome short more or less elongated, naked ; fronds usually solitary or few, straight in veneration, 2.5-12.5 cm long, but sterile part usually 2.5-6 cm long ; stipe 1-4 cm long, terete, elongated ; lamina or blade simple, 1-2.7 × 0.6-1.5 cm, ovate to ovate-oblong, margin entire, midrib usually indistinct ; texture herbaceous, green ; venation reticulate with few free veinlets at the margin ; fertile spike simple, 0.5-1.8 cm long, borne on a 0.5-8.5 cm long peduncle arising from the base of the blade, apex having a sterile projection or elongation of the axis ; sporangia borne in two alternate rows, fused together on the spike, each opening by a transverse slit ; spores globose, non-perisporiate, tetrahedral, exine thin and smooth (Fig. 1).

A low altitude species found growing among grass in exposed and rather dry conditions near Chetru at an altitude of 850 m.

SCHIZAECEOUS SERIES

Family SCHIZAEACEAE

Terrestrial ; rhizome creeping ; venation circinate ; sporangia regarded as marginal in origin, but often apparently dorsal, each with a complete distal annulus, dehiscence longitudinal.

*Lygodium* Swartz

Rhizome hairy (without scales) ; fronds scandant by twining rachises ; pinnae conjugate-palmate lobed ; sterile leaflets entire or toothed or regularly lobed ; veins free, forked, often uniting at their tips with a thickened margin ;



Fig. 1. *Ophioglossum vulgatum* ; A. A plant, × 4.7 (reduced) ; B. Leaf blade, showing venation, × 4.7 ; C. A fertile spike, × 4.7 ; D. Spores, × 291.

Fig. 2. *Lygodium flexuosum* ; A. A part of plant, × 3.7 (reduced) ; B. A sterile pinnule, × 3.7 ; C. A fertile pinnule, × 3.7 ; D. A fertile spike, × 8.7 ; E. A sporangium, × 80 ; F. Spores, × 292 ; G. Hair on the pinnules, × 80.

fertile leaflets narrower than sterile, fringed with narrow lobes along the edges ; each lobe bearing two rows of sporangia, each covered with small indusium, dehiscing by a vertical slit ; spores tetrahedral.

Pantropic in distribution with about 40 species. The genus is represented by only one species in the area.

**L. flexuosum** (L.) Sw. in Schrad, Jour., 1800<sup>2</sup>, 106 (pt.) 1801; Clarke, Trans. Linn. Soc. Lond., II, Bot., 1, 584, 1880.

Rhizome creeping, long, hairy; hairs unicellular; fronds stipitate-pinnate; climbing rachis up to 1 mm thick; secondary pinnae bearing alternately arranged pinnules, usually 3-5 on each side with a forked terminal pinnule, the whole being 4-15 cm long; largest secondary pinna 6.5 × 3.5 cm; stalk 1-5 mm long, broadly rounded to cordate at the base to sub-palmate or variously lobed, narrowing gradually at the apex, edges of the sterile segments finely toothed or serrated, hairy (hair unicellular); texture thin but firm, green; veins forked 1-3 times, very oblique at their origin from the midrib; fertile segments with lamina a little narrower than sterile; fertile lobes 1-4 mm long; sporangia in two alternate rows covered by a small indusium, pear shaped with an annular ring round the narrow end; spores tetrahedral non-perisporiate, exine thick and smooth (Fig. 2).

A rare fern found near Sidhpur at an elevation of 800 m growing along the forest margin twining around the bushes.

#### Family MARSILEACEAE

Typically sub-aquatic, heterosporus ferns, growing on mud; rhizome creeping, hairy; fronds simple and linear, circinate when young, without leaflets or with 2 or 4 opposite leaflets; veins forked, anastomosing; sori in hard structures called sporocarps at the base of stipes, consisting of mega and microsporangia, megaspores solitary, microspores numerous.

#### **Marsilea** Linn.

Fronds cruciform with two contiguous pairs of opposite leaflets, sori numerous attached to the inner wall of the sporocarp.

The genus has 70 species distributed all over the world. Only one species is found in the area under study.

**M. minuta** Linn., Mant., 308, 1771 (excluding  $\beta$ ), Mehra & Dhir, Bull. Bot. Surv. India, 10, 303, 1968.

Rhizome slender, submerged, creeping, hairy; hairs pleuri-cellular and uniseriate; fronds cruciform, erect, well spaced along with close groups of fronds on short branches of the rhizome and rooting at the base; roots often long and wiry; petiole glabrous, terete, 4-14 cm long; leaflets 4, arranged symmetrically cross-wise at the apex of the stipe, obovate, 1.5 cm both sides, with an entire, rounded apex and cuneate base; texture thin herbaceous, green; veins fine, dichotomously branched, anastomosing to form narrow radiating areoles; sporangia borne in a distinctly stalked sporocarp present at the base of the stipe; sporocarp ovoid in shape with two spines just close to the union of the stalk with the sporocarp; anterior spine often larger than the posterior one; spores of two kinds, mega and microspores; microspores globose, non-perisporiate with smooth exine (Fig. 3).

A common hydrophyte growing in the rice fields near Dari at an altitude of 850 m.

#### Family ADIANTACEAE

Terrestrial; rhizome creeping; fronds simple to pinnate, usually firm-herbaceous or coriaceous; veins free usually forked; sori marginal, globose to linear, usually numerous and distinct, sometimes confluent and continuous; indusium of the same shape as the sorus, formed of the reflexed margin of the fronds, bearing the capsules on its underside; spores tetrahedral.

#### **Adiantum** Linn.

Rhizome creeping or short-erect, scaly; scales brown to black and narrow; stipe dark-polished; lamina pinnately-decompound with

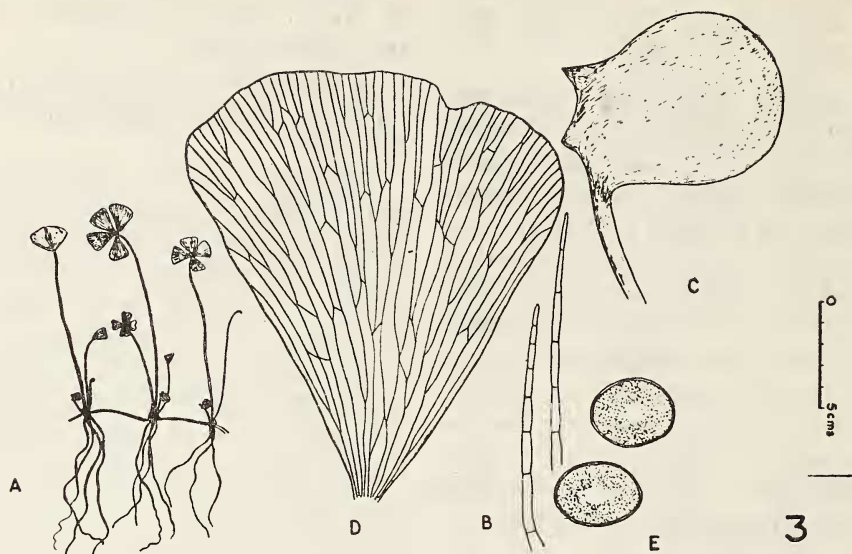


Fig. 3. *Marsilea minuta*; A. A plant,  $\times c$  3.6 (reduced); B. Hairs on the rhizome,  $\times c$  17.2; C. A sporocarp,  $\times c$  3.6; D. A leaf-let showing venation,  $\times c$  3.6; E. Spores,  $\times$  221.2.

dimidiate or flabellate pinnules, sometimes simply pinnate; veins free, extending into the reflexed margin; sori terminal on the veins, covered with reflexed margin of the frond; spores tetrahedral and smooth.

The genus is represented by more than 200 species in the world. Five species are reported from the area under investigation.

KEY TO THE SPECIES

- A. Fronds pinnate, rooting at the apex; pinnae entire or shallowly lobed.
- B. Stipe and rachis variously hirsute.
  - C. Lamina hirsute; pinnae dimidiate shortly-stalked, lobed  
.....*A. incisum*
  - C. Lamina glabrous; pinnae triangular, dimidiate, sessile with an almost straight upper margin  
.....*A. edgeworthii*

- B. Stipe and rachis glabrous; pinnae lunulate to sub-dimidiate, glabrous  
.....*A. lunulatum*

- A. Fronds decompose, not rooting at the apex.
  - B. Ultimate pinnules small, flabellate to obdeltoid, cuneate, aristately-serrate; indusia round-reniform attached to a notch  
.....*A. venustum*
  - B. Ultimate pinnules larger, dimidiate, lobed with oblique flabellate base; indusia transversely oblong or round-reniform  
.....*A. capillus-veneris*

**A. incisum** Forssk., Fl. Aeg. Ar. 187, 1775; Mehra & Bir, Res. Bull. Panjab Univ. (N.S), 15, 105, 1964.

Rhizome short, erect, densely scaly; scales brown, linear, hair pointed, 3-6 mm long; fronds fasciculated together, elongated and rooting at the apex; stipes terete, pubescent, 5-7 cm long, scaly, scales similar but smaller

than those of rhizome scales; lamina linear-lanceolate,  $20-37 \times 1-2.5$  cm; pinnae 10-35 jugate, basal ones somewhat smaller, deflexed and upper ones gradually diminished towards the apex; rachis hirsute throughout with long ferruginous hairs, distinctly scaly, scales linear, hair pointed; pinnules hairy, shortly stalked, anterior inner base truncate, margin deeply incised into 3-5 lobes, generally  $1 \times 0.5$  cm; texture herbaceous green; veins fine, flabellately forked; sori 3-5 on each pinnae, present at the margin of each lobe; indusium laterally oblong or sub-reniform, brown, glabrous; sporangia with 15-celled annulus; spores tetrahedral, trilete, non-perisporiate, exine smooth (Fig. 4).

A very common low altitude fern found near Chari at 850 m, growing on shaded walls along the road.

**A. edgeworthii** Hook., Sp. Fil., ii, 14, t. 81B, 1851; Bedd., Handb. Ferns Brit. India, Suppl., 17, 1892.

Rhizome short, erect, wiry, sparsely scaly at the apex; scales brown, lanceolate, subulate, rigid; fronds fasciculated, several together; stipes terete, glossy, castaneous, 4-10 cm long, wiry but firm, glabrous with a scaly base; scales linear, hair pointed and uniseriate; lamina linear-lanceolate, 8-14 cm long, 1.5-2.3 cm broad; pinnae 8-28 jugate, patent, basal ones somewhat smaller, deflexed, upper ones gradually diminished towards the apex, sessile, dimidiate,  $1-1.2 \times 0.5-0.6$  cm, apex rounded, anterior inner base truncate, margin more or less lobato-incised, sterile pinnae cut nearly half way down into 3-5 oblong, roundish or bifid segments; primary rachis scaly; scales linear, hair pointed and uniseriate; texture herbaceous;

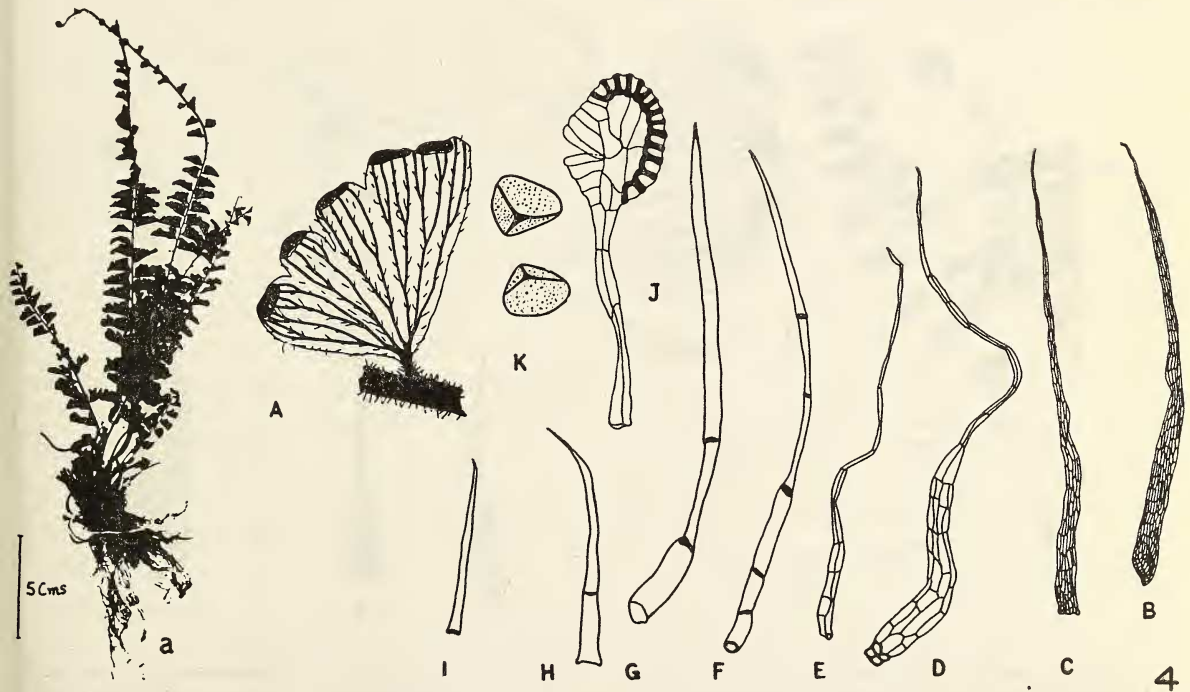


Fig. 4. *Adiantum incisum*; a. A plant; A. A pinna showing venation,  $\times c 4$ ; B, C. Rhizome scales,  $\times c 11.2$ ; D, E. Stipe scales,  $\times c 18.6$ ; F, G. Hairs on the rachis,  $\times c 85.2$ ; H, I. Hairs on the pinnae,  $\times c 85.2$ ; J. A sporangium,  $\times c 85.2$ ; K. Spores,  $\times 248$ .

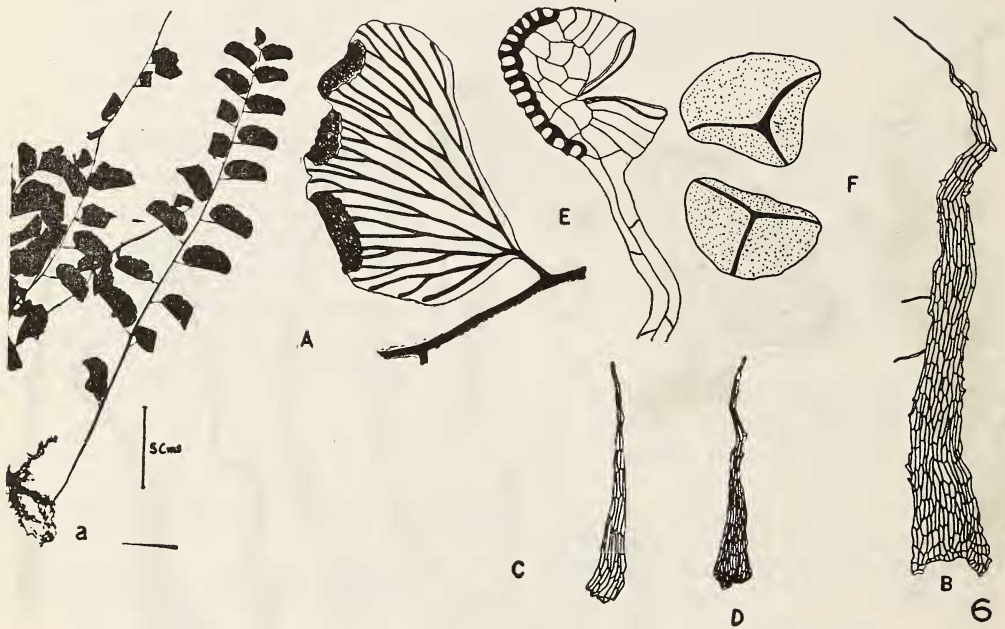
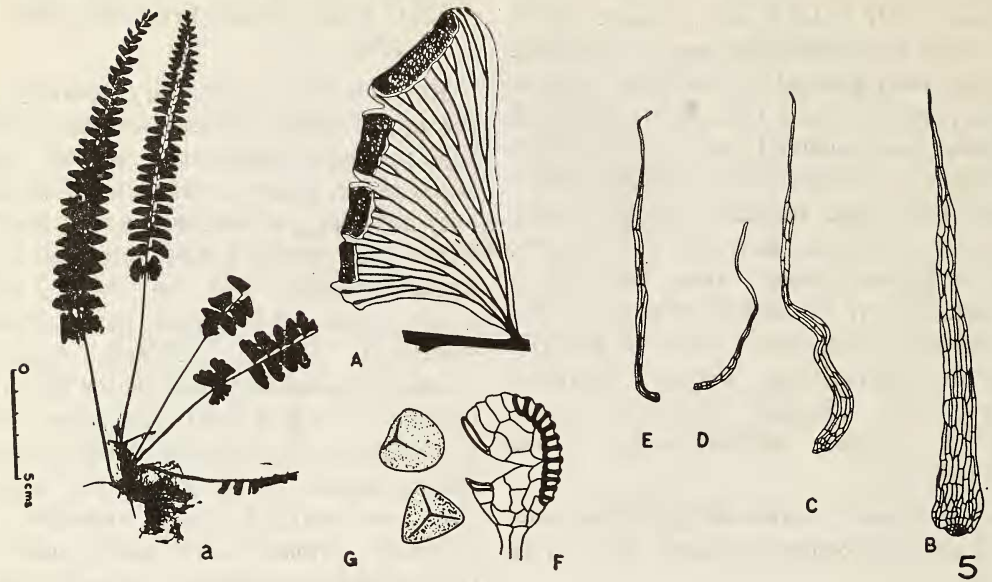


Fig. 5. *Adiantum edgeworthii*; a. A plant; A. A pinna showing venation,  $\times c 4$ ; B. A rhizome scale,  $\times c 18.6$ ; C. A stipe scale,  $\times c 18.6$ ; D, E. Scales of the rachis,  $\times c 85.2$ ; F. A sporangium,  $\times c 85.2$ ; G. Spores,  $\times 248$ .

Fig. 6. *Adiantum lunulatum*; a. A plant; A. A pinna showing venation,  $\times c 4.4$ ; B. Rhizome scale,  $\times c 12.4$ ; C, D. Stipe scales,  $\times c 21.2$ ; E. A sporangium,  $\times c 96$ ; F. Spores,  $\times 277.2$ .

veins fine, flabellately forked ; sori 2-7 to each pinna ; indusium laterally oblong or sub-reniform, brown, glabrous ; sporangia with 13-celled annulus ; spores with characteristic tri-radiate markings, tetrahedral, non-perisporiate, exine smooth (Fig. 5).

A rare fern of the area found along the road side in moist and shady places near Dari at 850m.

**A. lunulatum** Burm. Fl. Ind. 235, 1768 ; Clarke, Trans. Linn. Soc. Lond., II, Bot., 1, 452, 1880.

Rhizome short, erect, wiry, densely scaly at the apex ; scales dark-brown, ovate-lanceolate, subulate, hair-pointed, 1-3 mm long ; fronds caespitose, elongated and rooting at the apex ; stipes dark chestnut brown, terete, glossy or castaneous, scaly below, glabrous above, 2-21 cm long ; lamina linear-lanceolate, 9-33 cm × 2-8 cm, unipinnate ; pinnae 2-15 jugate, sub-dimidiolate, the basal ones larger and uppermost ones gradually diminished in size towards the apex, provided with long, shining 0.2-2.5 cm long stalk, nearly in line or oblique to the rachis, alternate, half-moonshaped, inner basal part truncate, margin more or less lobato-incised or entire ; veins fine, flabellately forked ; indusium laterally-oblong, glabrous, curved ; sporangia with 14-16 celled annulus ; spores tetrahedral, tri-radiate, non-perisporiate with thick smooth exine (Fig. 6).

A common low altitude species growing luxuriously on humus rich shaded walls along the roads. Seen near Dharamsala and Chetru between 800-1350 m.

**A. venustum** D. Don, Prod. Fl. Nepal, 17, 1825 ; Clarke, Trans. Linn. Soc. Lond., II, Bot., 1, 453, 1880.

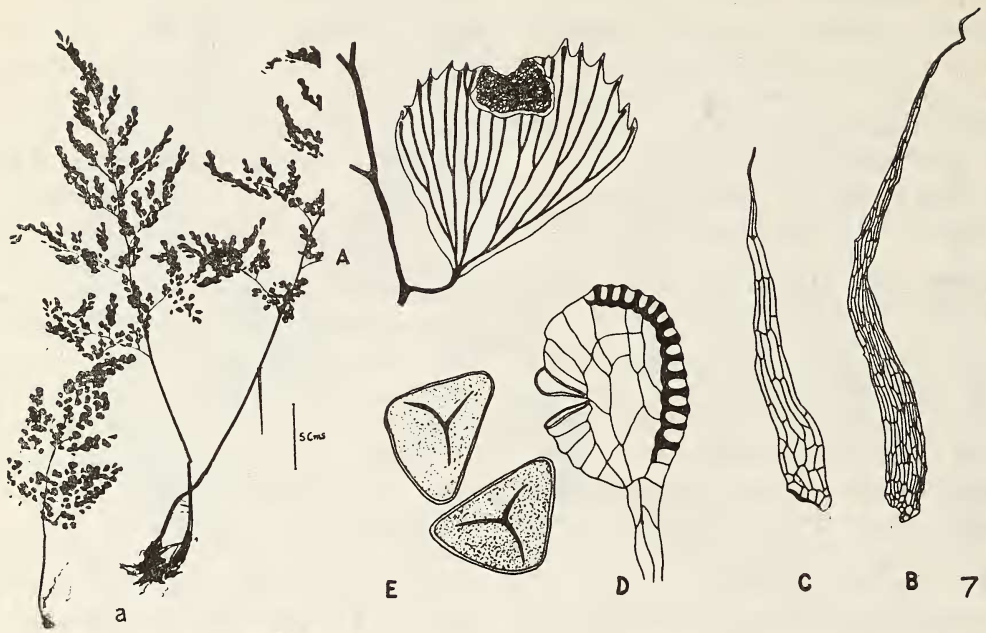
Rhizome wiry, widely-creeping, growing point densely clothed with scales ; scales nitide, light-brown, ovate-lanceolate, hair pointed, entire ; fronds caespitose ; stipe castaneous slender, firm, terete, glossy, 11-25 cm long, glabrous above the scaly base ; lamina deltoid-ovate,

shorter than stipe, tripinnate ; pinnae 2-5 jugate under elongate pinnatifid apex, petiolate, basal ones the largest, deltoid-lanceolate, 4-13 cm long, 3.5-6 cm broad ; pinnae of second order oblong, petiolulate, obtuse, with 1-4 pairs of ultimate close pinnules which are of flabellate shape with rounded, dentate aristately serrate outer margin, distinctly petiolulate, 2-6 mm each way ; rachis, rachilets, costa and petiolules shining or castaneous ; texture herbaceous, glabrous above, glaucous beneath, fertile lobes with 1-3 notches, each with a sorus at the bottom ; indusium light brown, thick rotundo-reniform, 1-1.5 mm long with sterile margin on both sides, aristately-serrate ; sporangia with 14-16 celled annulus, spores trilete, non-perisporiate, smooth (Fig. 7).

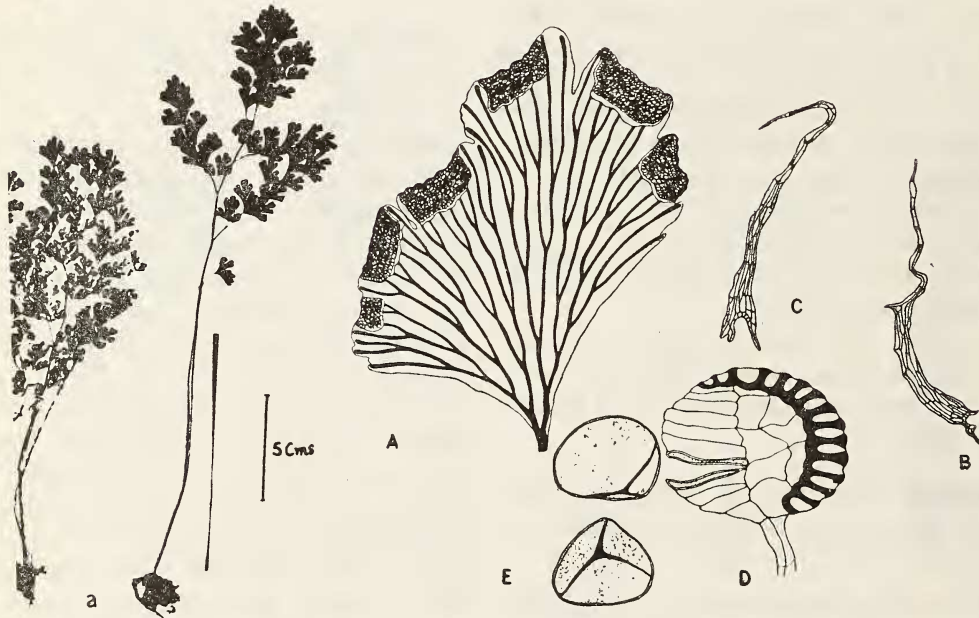
This is a fern of shaded and humus rich habitats. Frequently observed near Mcleodganj and Khanjar Mahadev Temple at 1300 m.

**A. capillus-veneris** Linn., Sp. Pl. 2, 1096, 1753 ; Clarke, Trans. Linn. Soc. Lond., II, Bot., 1, 453, 1880.

Rhizome short, creeping, densely clothed at apex with dark-brown, linear, entire, scales ; fronds caespitose ; stipes 3-18 cm long, glossy, ebeneous, naked ; lamina deltoid-ovate, 8-18 cm long, 3-6 cm broad, usually bipinnate ; pinnae 1-5 jugate, alternate, with zigzag rachis, petiolate, basal ones much the largest, oblong-ovate, 1-5 cm long, 1-2.5 cm broad ; pinnules 5-7 jugate, petiolate, alternate, the lower ones pinnate, upper ones 2-3 foliolulate, the uppermost ones simple, rachilets also strongly flexuose ; penultimate pinnules 1-1.5 cm each way, flabellate with sinuate outer margin, petiolulate ; lobes entire with deeply incurvate outer edge ; texture membranaceous, green ; veins fine, flabellately forked ; sori one to each lobe, 2 mm each way ; indusium more or less curved, brown, persistent ; sporangia with usually 15-celled annulus ; spores trilete, non-perisporiate with smooth exine (Fig. 8).



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Fig. 7. *Adiantum venustum*; a. A plant; A. A pinnule showing vein pattern,  $\times c 5$ ; B. A rhizome scale,  $\times c 5$ ; C. Scale at base of stipe,  $\times c 24.2$ ; D. A sporangium,  $\times c 109$ ; E. Spores, 315.

Fig. 8. *Adiantum capillus-veneris*; a. A plant; A. A pinnule showing venation,  $\times c 4.4$ ; B, C. Rhizome scales,  $\times c 12.4$ ; D. A sporangium,  $\times c 96$ ; E. Spores,  $\times 277.2$ .



It generally prefers moist and humus rich places along water channels. Occasionally found near Dharamsala, Chetru and Kangra between 800-1350 m.

Family CRYPTOGRAMMACEAE

Terrestrial; rhizome creeping, solenostelic, short or compact, scaly; fronds decompoundly pinnate, sometimes dimorphic, ultimate pinnales small and narrow, glabrous, herbaceous or sub-coriaceous; veins free, forked; sori continuous along both margins, covered with scarious introrse marginal or sub-marginal indusium, so broad that the two on each pinnule meet on the costa, without paraphyses; spores tetrahedral, hyaline, ribbed or tuberculate episporic.

*Onychium* Kaulf.

Sori placed upon a continuous linear receptacle, which connects the apices of several veins; indusium parallel with the margin of the segments, linear, pressed down over the sori, the edge nearly or quite reaching the midrib.

The genus has about 10 species distributed in the Indo-Japanese region. One species is recorded presently.

*O. contiguum* Hope, Jour. Bomb. nat. Hist. Soc., 13, 444, 1901; Mehra & Bir, Res. Bull. Panjab Univ. (N.S.), 15, 108, 1964.

Rhizome 0.8-1.5 cm thick, short, procumbent, densely scaly, apex clothed with lanceolate, light-brown, castaneous scales; fronds caespitose; stipes 15-27 cm long, black at the base, pale-straminous above; lamina glabrous 25-40 × 15-26 cm, broadly-ovate, acuminate, very finely 5-pinnate; pinnae 8-12 jugate, the basal pair much the largest, triangular, acuminate, petiolate, oblique; pinnules of 2nd and 3rd order petiolate, united; ultimate segments linear-lanceolate, apiculate, entire, 3-5 mm

long; texture herbaceous, pale-green, naked on both sides; veins fine, one to each segment, fall short of the acute apex, clavate; sori linear, short; indusia large, broad, membranaceous, pale-grey, entire, persistent, reaching the costule from both sides, rather overlapping; sporangia with 20-21 celled annulus; spores tuberculate with ridge-like projections giving rugose appearance, reticulations sparse (Fig. 9).

It is an elegant fern of humus rich forest floors near Dharmkot at an elevation of 1950 m. Occasionally it covers large areas and borders the forest.

Family SINOPTERIDACEAE

Terrestrial; rhizome short-creeping or erect bearing tufts of fronds, scaly; fronds small pinnate to decompound, narrow to broadly-deltoid; veins free; sori marginal on the tips of the veins; indusium formed by the reflexed margin, discrete but often more or less confluent; spores globose to tetrahedral without perispore.

*Cheilanthes* Swartz

Fronds sub-coriaceous, 3-4 pinnatifid; veins free, forked; sori on the tips of veins along the laminar edge, more or less protected by reflexed marginal flaps; spores tetrahedral, granulose to tuberculate.

The genus has about 200 species, distributed in tropical and warm temperate regions, characteristically inhabiting dry but cool places. It is represented by 4 species in Dharamsala Hills.

KEY TO THE SPECIES

- A. Scales bicoloured; lamina lanceolate to deltoid.
- B. Scales present on rachises and costae; indusium margin lacerated or having finger-like projections  
.....C. *albomarginata*
- B. Scales present upto principal rachis and do not extend beyond to rachilets and pinnules;

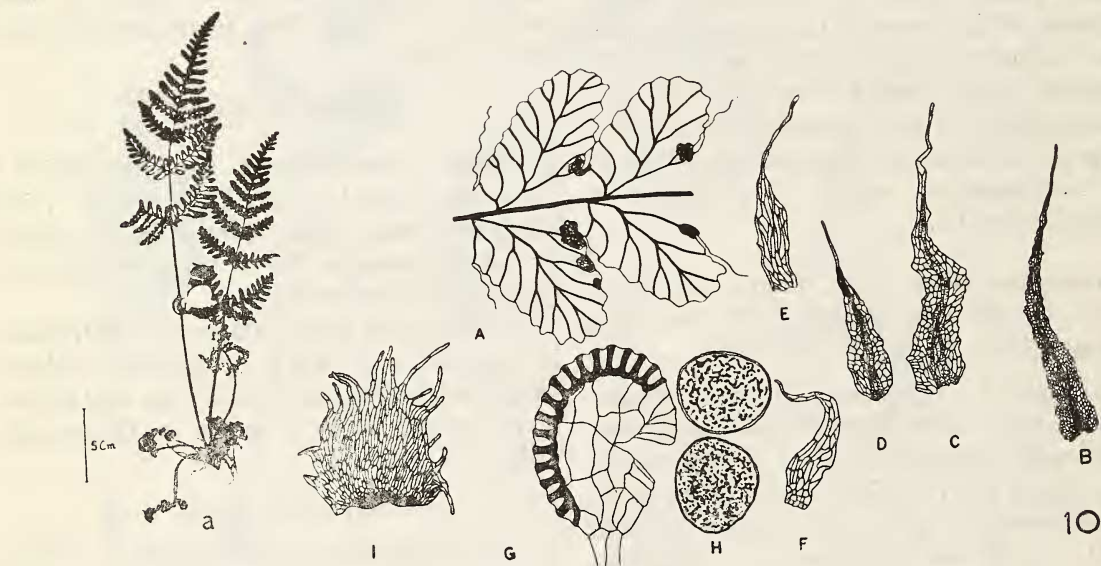
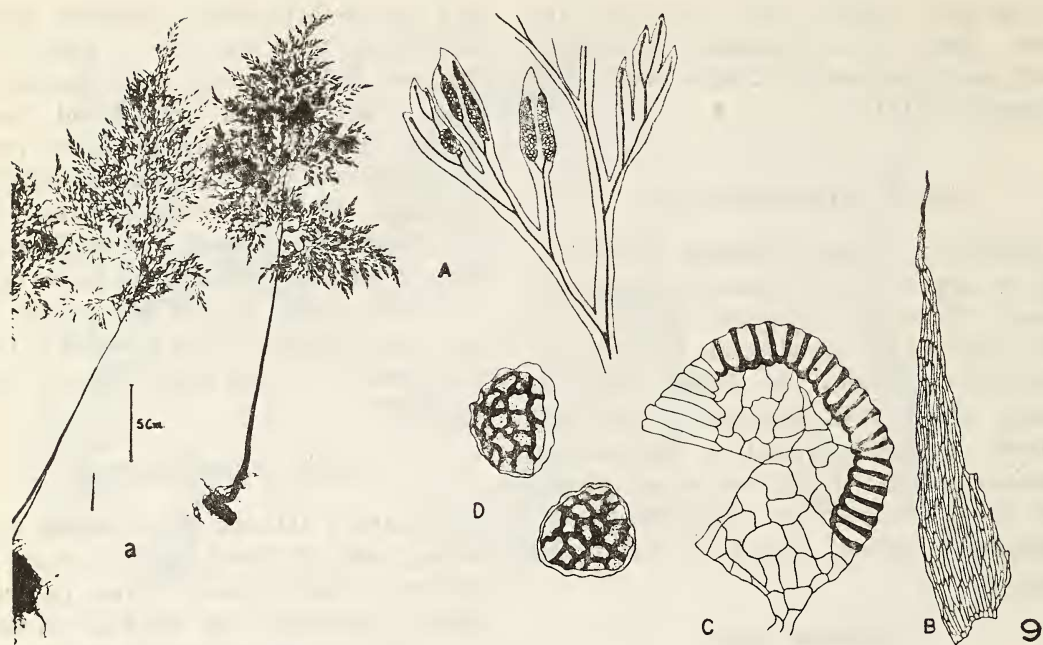


Fig. 9. *Onychium contiguum* ; a. A plant ; A. Ultimate pinnules showing venation and position of sori,  $\times c 1.7$  ; B. A rhizome scale,  $\times c 11.6$  ; C. A sporangium,  $\times c 88.8$  ; D. Spores,  $\times 256.6$ .

Fig. 10. *Cheilanthes albomarginata* ; a. A plant ; A. A part of the pinna showing the vein pattern and position of sori,  $\times c 3.4$  ; B. A rhizome scale,  $\times c 5.8$  ; C. A stipe scale,  $\times c 9.4$  ; D. A scale on the rachis,  $\times c 12$  ; E, F. Scales on the rachilets,  $\times c 12$  ; G. Sporangium,  $\times c 73.2$  ; H. Spores,  $\times 210$  ; I. Indusium,  $\times c 12$ .

lamina lanceolate and farinose ; indusium sub-entire

.....*C. anceps*

B. Scales present only at the base of the stipe ; indusium margin with numerous glandular cells

.....*C. farinosa*

A. Scales concolorous, lamina deltoid-lanceolate to deltoid.

B. Scales large, membranaceous, thin papery ; lamina never farinose ; indusium with toothed margin

.....*C. dalhousiae*

B. Scales at the stipe sometimes concolorous but not membranaceous

.....*C. farinosa*

**C. albomarginata** Clarke in Trans. Linn. Soc. Lond., II, Bot., 1, 456, t. 52, 1880 ; Bedd., Handb. Ferns Brit. India, 94, 1883.

Rhizome short, ascending to sub-erect, broader upwards, narrow below, densely scaly ; scales 3-6 × 0.5-1 mm, deltoid to deltoid-lanceolate, hair uniseriate and pointed, bicoloured, margin smooth sometimes with peg-like projections near the base, central region dark-brown with hyaline peripheral cells ; fronds closely tufted, paleaceous, deltoid or deltoid-lanceolate ; stipes hard, deep-brown, cylindrical, 4-18 cm long, without groove ; scaly althrough ; scales like those of rhizome except for smaller in size ; lamina deltoid-lanceolate, 6-24 × 3.5-10 cm, unipinnate above, bipinnate below with extreme apex pinnatifid, sub-basal pinnae the largest, rachis and rachilets prominent, scaly ; scales on the rachis bicoloured but on the rachilets concolorous or bicolorous ; lamina densely farinose underneath ; farina either white, cream-yellow or even yellow ; sori mixed, occur superficially on the under-surface at the dilated vein ends ; veins finely forked ; sori covered by a broad, membranaceous, lacerated indusium ; sporangia conspicuously large, pyriform to globose, with 18-20 celled annulus, stalked ; spores dark-brown, globose tetrahedral, exine densely verrucose (Fig. 10).

A common fern of moist and humus rich walls in exposed situations near Forsytheganj, Mcleodganj and Khanjjar Mahan Dev Temple between 1600-1800 m.

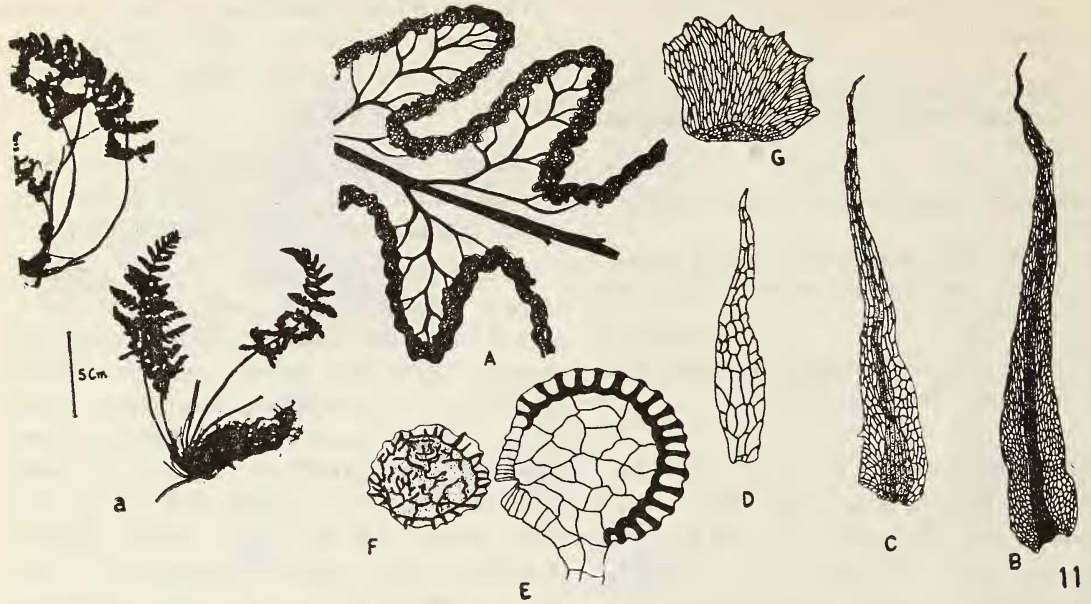
**C. anceps** Blanford in Simla nat. Hist. Soc. Leaflet, 25th June, 1886 ; Mehra & Bir, Res. Bull. Panjab Univ. (N.S.), 15,109, 1964.

Rhizome short, ascending, broader upwards, narrow below, densely scaly ; scales 3-4 × upto 0.5 mm, linear-lanceolate, hair uniseriate, pointed, bicoloured, margin smooth ; fronds fasciculate or caespitose, lanceolate, under surface thickly coated with white powder ; stipes hard, cylindrical, deep chestnut coloured, 3-15 cm long, scaly ; scales like the rhizome scales except for the size ; lamina deltoid-lanceolate, 8-18 × 3-9 cm, unipinnate above, bipinnate below with extreme apex pinnatifid ; basal pinnae the largest ; rachis and rachilets prominent, scales on the principle rachis and not beyond that ; scales usually concolorous ; sori contiguous, occur superficially on the under surface at the vein ends ; veins finely forked ; indusium more or less continuous, with a broadly lobed margin ; sporangia large, globose with 20-22 celled annulus ; spores dark-brown, globose, tetrahedral, narrow flap-like ridges on the exine (Fig. 11).

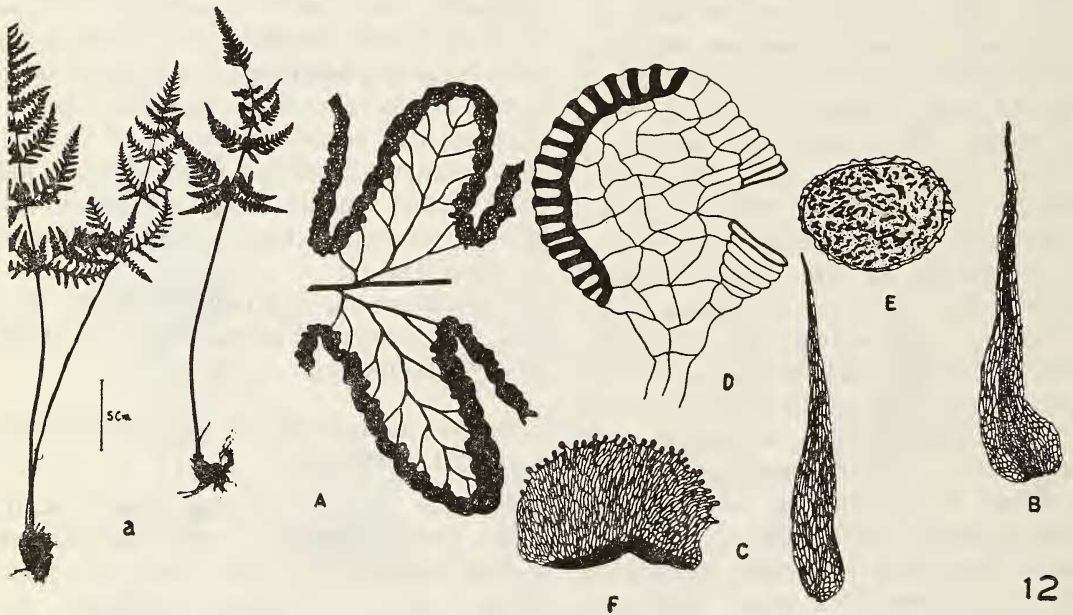
Frequent on exposed rocks along the roads near Dharamsala, Chetru, Dari and Chari between 800-1400 m.

**C. farinosa** sensu Blanford in Asiat. Soc. Bengal, 57 : 301, 1888.

Rhizome short, ascending, densely scaly ; scales linear-lanceolate, hair uniseriate and pointed, usually 4-6 mm × 0.5-1 mm, bicoloured, margin smooth ; fronds caespitose, sub-coriaceous, deltoid-lanceolate or lanceolate, glabrous, white powdery beneath ; stipe more or less elongated 15-25 cm long, ebeneous, chestnut coloured, hard, deciduously scaly ; scales concolorous rarely bicoloured, linear-lanceolate.



11



12

Fig. 11. *Cheilanthes anceps*; a. A plant; A. A part of the pinna showing venation, and position of sori,  $\times c 4.4$ . B. A rhizome scale,  $\times c 12.4$ ; C. A stipe scale,  $\times c 21.2$ ; D. Scale on the rachis,  $\times c 21.2$ ; E. Sporangium,  $\times c 61.2$ ; F. Spore,  $\times 277.2$ ; G. Indusium  $\times c 21.2$ .

Fig. 12. *Cheilanthes farinosa*; a. A plant; A. A part of the Pinna showing venation,  $\times c 1.6$ ; B. Rhizome scale,  $\times c 11.6$ ; C. Stipe scale,  $\times c 11.6$ ; D. Sporangium  $\times c 88.8$ ; E. Spore,  $\times 256.6$ ; F. Indusium,  $\times c 18.6$ .

3-4 × upto 0.5 mm, hair pointed ; lamina farinose, deltoid to deltoid-lanceolate, 10-18 × 6-12 cm, bipinnate above, bipinnate below, sub-basal pinnae the largest ; rachis and rachilets naked, glossy, castaneous ; texture sub-coriaceous, green ; sori contiguous, occur superficially on the under surface at the vein ends ; veins finely forked ; indusium brown, globose, sometimes confluent, with glandular margin ; sporangia large, globose with 20-24 celled annulus ; spores globose to tetrahedral with flap-like ridges on the exine (corrugated) (Fig. 12).

It is a fern of rock crevices and grows under shade. Commonly found near Chamundey Temple at 1200 m.

**C. dalhousiae** Hook., Sp. Fil., 2,80, t. 75B, 1852 ; Mehra and Bir, Res. Bull. Panjab Univ., (N.S.), 15, 109, 1964.

Rhizome short, ascending to sub-erect, densely scaly, scales 3-8 × 1-3 mm, ovate-lanceolate concolorous, membranaceous, yellowish-brown ; fronds caespitose, deltoid-lanceolate thin in texture ; stipes 10-13 cm long, firm ebeneous, glossy, deciduously scaly at the base scales large ovate-lanceolate, concolorous with smooth margin ; lamina deltoid-lanceolate to lanceolate, glabrous on both sides 10-16 × 4-8 cm, never farinose ; sori at the vein ends, protected by involucre ; indusium close but distinct, sometimes confluent, with a toothed or lacerate margin ; sporangia large, globose with 18-22 celled annulus ; spores dark-brown, globose-tetrahedral with scanty ridges or flaps on the exine (Fig. 13).

Occasionally found growing in moist and shaded localities near Dharmkot at an elevation of 1950 m.

#### Family GYMNOGRAMMACEAE

Terrestrial ; rhizome short-creeping or rudimentary, paleate ; fronds small to fairly large, pinnate to tripinnate with few and large, entire to incised leaflets, herbaceous or more firm ;

veins free, forked, ending in hydathodes ; sori elongate along the veins except near the margin, exindusiate ; spores bilateral or tetrahedral, smooth or faintly ribbed.

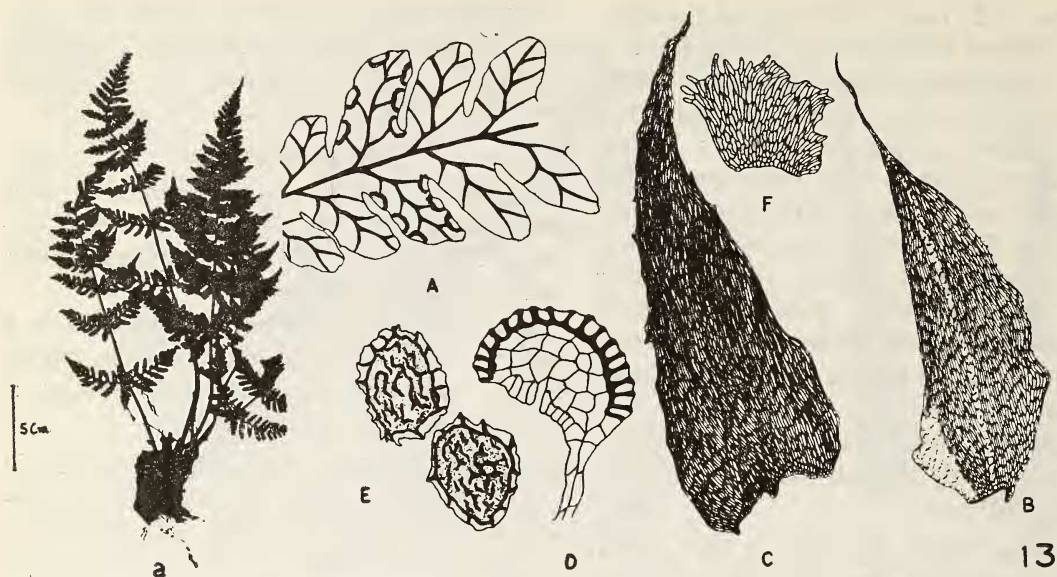
#### Coniogramme Fee

Rhizome scales rather narrow ; stipe grooved ; texture herbaceous ; veins free, distinct, forked near the base ; spores yellow, tetrahedral, non-perisporiate.

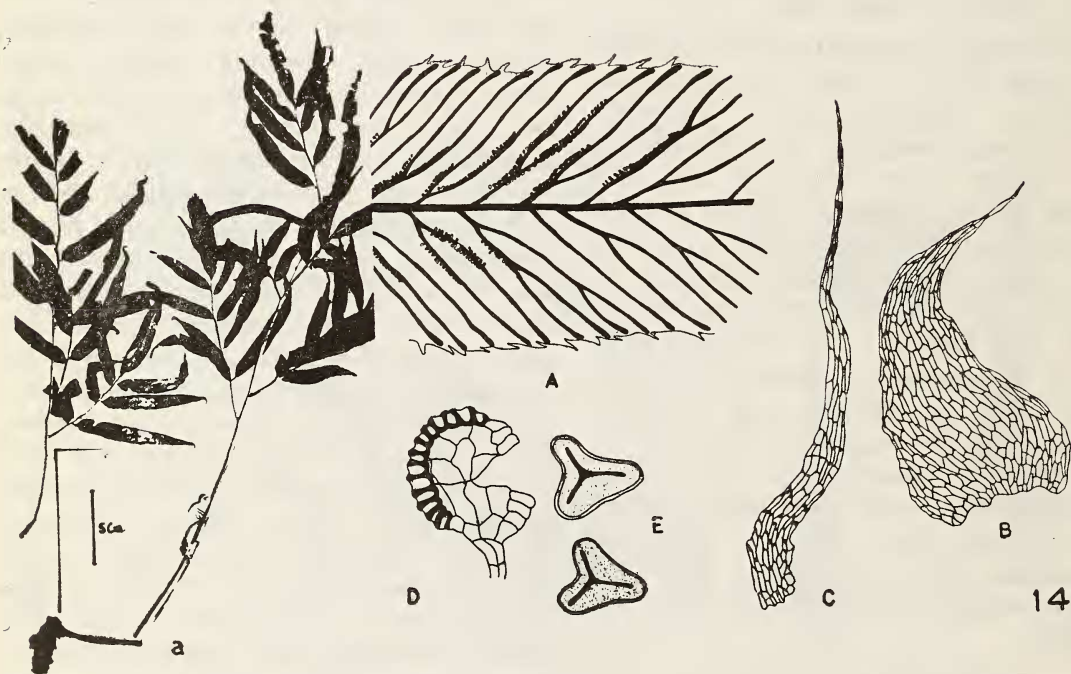
A small genus of about 20 species with a limited distribution in Sino-Japanese region, Africa and Mexico. Only one species is reported from the present area.

**C. intermedia** Hieron., Hedwigia, 57, 301, 1916 ; Ching, Ic. Fil. sinica., Pl. 143, 1935 (description only) ; Mehra & Dhir, Bull. Bot. Surv. India, 10, 304, 1968.

Rhizome 0.8-1 cm thick, wide-creeping, densely scaly ; scales brown, ovate-lanceolate, acuminate with sub-entire margin ; fronds distant ; stipes 20-25 cm long, glabrous above the scaly base (scales linear-lanceolate, acuminate), pale-straminous, terete below, grooved above ; lamina ovate-deltoid, 30-45 × 15-35 cm, bipinnate at the base, simple pinnate above, lateral pinnae 3-6 jugate, alternate, the basal ones much the largest, more or less opposite and petiolate, 4-15 cm long, tripinnate but rarely pinnate also, the upper ones simple but sometimes the second pinnae further divided, petiolate but rarely the uppermost ones adnate, 5-8 × 1-1.5 cm, broadly-lanceolate with attenuate apex, base rounded or rotundo-cuneate, margin sharply serrate ; texture herbaceous, light-green, glabrous ; rachis naked, glossy, pale-straminous ; veins free, distinct, oblique, generally forked near the base, veinlets fine, parallel, extending till the base of teeth with a clavate apex ; sori pale-brown, exindusiate, following the veinlets, till a short distance from the margin ; sporangia with 15-celled annulus ; spores tetrahedral, trilete, non-perisporiate, exine thick and smooth (Fig. 14).



13



14

Fig. 13. *Cheilanthes dalhousiae*; a. A plant; A. A part of the pinna, showing venation,  $\times c 1.6$ ; B. Rhizome scale,  $\times c 11.6$ ; C. Stipe scale,  $\times c 11.6$ ; D. Sporangium,  $\times c 88.8$ ; E. Spores,  $\times 256.6$ ; F. Indusium,  $\times c 18.6$ .

Fig. 14. *Coniogramme intermedia*; a. A plant; A. Part of the Pinnule showing venation and position of sori,  $\times c 4.4$ ; B. Rhizome scale,  $\times c 12.4$ ; C. Scale on the base of stipe,  $\times c 21.2$ ; D. Sporangium,  $\times c 61.2$ ; E. Spores,  $\times 277.2$ .

The present taxon conforms to the var. *glabra* Ching.

It is a high altitude fern growing on humus rich forest floor in exposed situations, sometimes covering large areas. Seen near Triund at 2700 m.

Family PTERIDACEAE

Rhizome erect or creeping, scabrous ; veins free or anastomosing ; sori marginal, linear, continuous, borne on a marginal connecting commissure ; indusium the same shape as the sorus, usually membranaceous ; spores tetrahedral, surface usually papillose or reticulate.

*Pteris* Linn.

Rhizome erect or creeping, bearing tufts of 2-3 pinnate fronds, scaly ; veins free except in the sori ; sorus continuous along the margin, protected by the reflexed margin, paraphysate ; spores tetrahedral sculptured.

A genus of more than 280 species with a tropical distribution extending to New Zealand, Africa, Japan and United States. Presently it is represented by 3-species.

KEY TO THE SPECIES

- A. Pinnae all simple, entire, sessile, lower ones gradually reduced  
.....*P. vittata*
- A. Pinnae deeply lobed or the lowest pair branched.
  - B. Lamina oblong with basal pinnae divided into 2-4 linear-pinnules ; sterile pinnae stalked with serrate margin ; spores smooth  
.....*P. cretica*
  - B. Lamina bipinnatifid with lower pinnae bipartite or even bipinnate ; pinnae stalked with sub-entire segments  
.....*P. quadriaurita*

*P. vittata* Linn., Sp. Pl., 1074, 1753, Mehra and Dhir, Bull. Bot. Surv. India 8, 304, 1968.

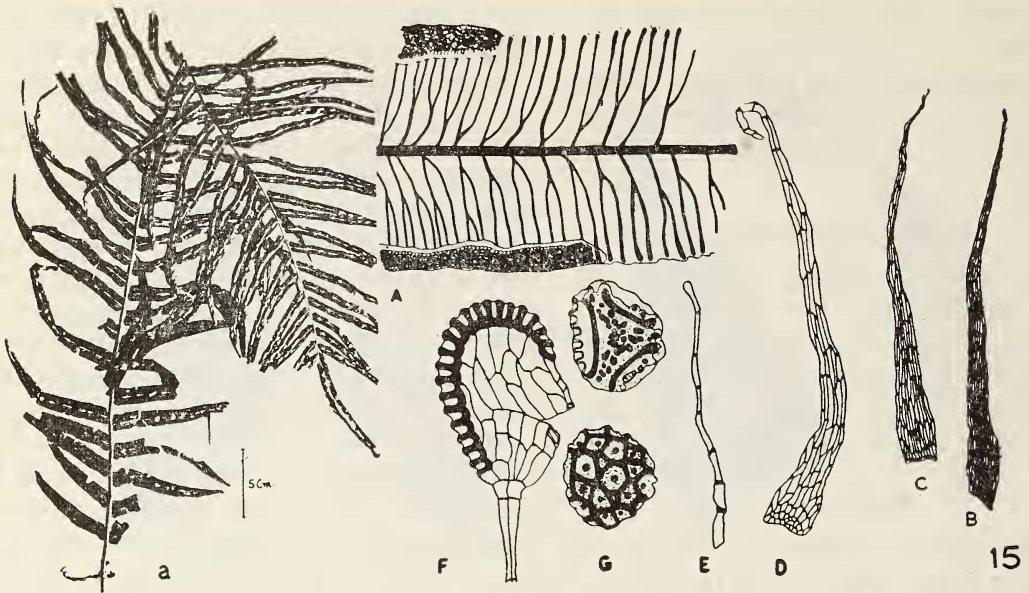
Rhizome 1-1.5 cm thick, short, sub-erect, densely covered with pale-brown, shining scales ; scales 0.4-0.8 cm long, linear-lanceolate,

hair pointed, concolorous, entire ; fronds sub-caespitose, oblong-lanceolate, pinnate with a terminal pinna like the lateral ones ; stipes 5-20 cm or more in length, rigid, pale, scaly almost throughout, but the stipe, rachis and rachilets are thickly pubescent in the smaller forms ; pinnae 30-40 pairs, 1-5 cm apart, pubescent, basal ones gradually reduced and often very short, upper ones slightly reduced but much shorter than the terminal pinna except in large fronds, all pinnae sessile and oblique ; largest pinnae 6-12 × 0.4-0.7 cm, base broadly cuneate to cordate, apex acuminate ; rachis distinct and scaly ; texture sub-coriaceous ; veins fine distinct on both surfaces, nearly at right angle to the costa, usually forked, not anastomosing ; sori continuous from near the base to near the apex of each pinna ; indusium membranaceous and yellowish brown ; sporangia with 22-celled annulus, intermixed with pleuricellular hairs ; spores non-perisporiate, reticulate (Fig. 15).

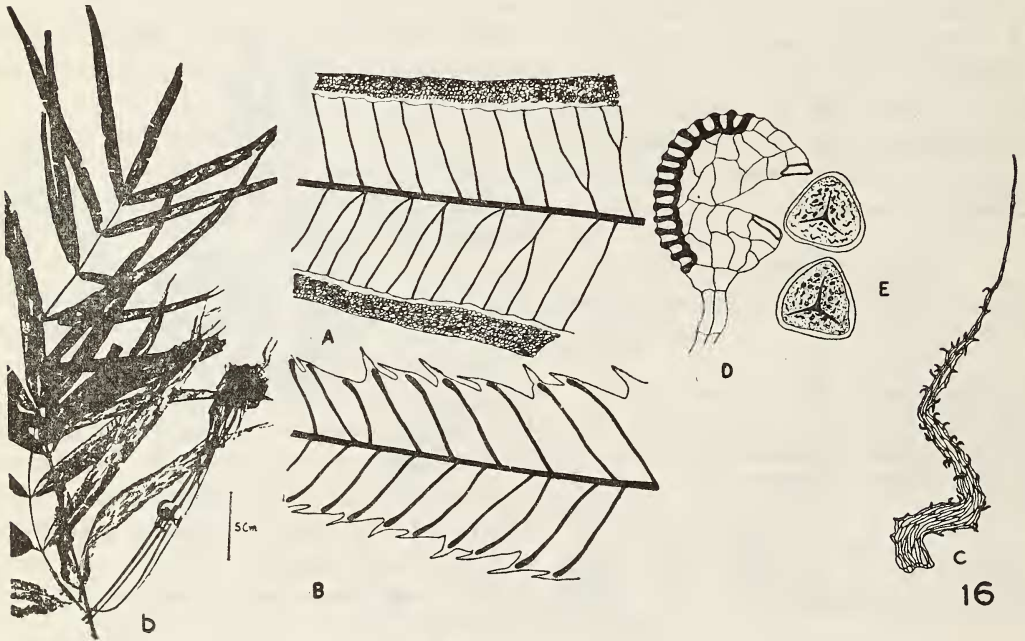
This species is locally abundant along the streamlets where sufficient humus has accumulated. Met with near Dari, Chari and Chetru between 800-900 m.

*P. cretica* Linn., Mant., 130, 1767, Bedd., Handb. Ferns Brit. India, 106, 1883.

Rhizome 0.5-1.5 cm thick, short, suberect, sparsely scaly ; scales pale-brown, linear-lanceolate, 4-6 mm long, hair uniseriate and pointed, dentate ; fronds caespitose ; stipes 20-40 cm long, erect, wiry, naked, straw-coloured and shining ; lamina 20-25 × 10-15 cm, oblong, with distinct purplish rachis, pinnate ; basal pinnae further divided with secondary pinnae having adnate decurrent bases ; pinnae 7-15 × 1-1.5 cm, terminal pinnae longer than the rest of the pinnae below, sterile pinnae broader with spinulose-serrate margin ; texture coriaceous, green ; veins usually once forked near the costa only, 40-60 veins, ending just within the margin, costa raised and grooved above ; fertile pinnae



15



16

Fig. 15. *Pteris vittata*; a. A plant; A. Part of the pinna showing venation and position of sori,  $\times c 1.6$ ; B. Rhizome scale,  $\times c 11.6$ ; C. Stipe scale,  $\times c 11.6$ ; D. Scale of the rachis,  $\times c 19.6$ ; E. Hair on the rachis, rachilets and among sori,  $\times c 34.4$ ; F. Sporangium,  $\times c 88.8$ ; G. Spores,  $\times 256.6$ .

Fig. 16. *Pteris cretica*; a. A plant; A. Part of fertile frond showing venation and position of sori,  $\times c 4$ ; B. Part of the apex of the pinnule showing vein pattern,  $\times c 4$ ; C. Rhizome scale,  $\times c 10.9$ ; D. Sporangium,  $\times c 85.2$ ; E. Spores,  $\times 248$ .



usually soriferous all along the edges except for a short distance from the apex where the edges are undulate and hardly toothed; sori rather broad when mature; indusium pale membranaceous; sporangia with 16-17-celled annulus; spores trilete, tetrahedral, perisporiate (Fig. 16).

Grows along the road side in moist and humus rich soil conditions. Frequently met with near Khanjar Mahan Dev Temple and Dharamkot between 1700-2000 m.

**P. quadriaurita** Retz. in obs. Bot., 6, 38, 179 (sensu lato): Bedd., Handb. Ferns Brit. India, 110, 1883.

Rhizome short, oblique, densely scaly; scales dark-brown, lanceolate, rigid, appressed; fronds caespitose; stipes 15-40 cm long, rufo-straminous near the base, light-coloured upwards, scales at the base similar but smaller to rhizome scales; lamina broadly ovate-lanceolate, 30-40 × 15-26 cm; pinnae 7-11 jugate under a single apical pinna; the basal pinnae the largest, deltoid with 1-2 additional pinnules on the lower side of the costa, all sessile with shortly decurrent base; the middle ones 13-15 cm long, 2.5-3 cm broad, pinnatifid nearly down to costa into 20-30 pairs of linear, sub-falcate, obtuse segments under the caudate, entire apex; segments 0.5-1.5 × 0.4-0.6 cm; veins 6-14 forked pairs of which posterior basal one 2-4 times forked; veinlets almost reach the margin with a clavate apex and meet the marginal commissure; texture sub-coriaceous, green, glabrous; rachis pale-colored, terete below, furrowed on the dorsal side with a spine at the base of each pinna; sori continuous from near the sinus reaching upto the apex of the segment; indusium membranaceous, grey, entire; sporangium with 17-21 celled annulus; spores trilete, perisporiate; perispore folded (Fig. 17).

It grows luxuriously on shaded and humus rich walls along the road near Khanjar Mahan Dev Temple at an elevation of 1700 m.

HYMENOPHYLLACEOUS SERIES

Family HYPOLEPIDACEAE

Terrestrial, rhizome creeping, more or less densely covered with hairs; vascular system a solenostele; fronds large, pinnately compound, coriaceous; veins free or joined at the margin with a commissure, forked; sori apical on the veins or nearly so or close to the margin and protected by a small thin reflexed margin (outer or false indusium), the inner (true) one developed or obsolescent; spores tetrahedral-oblong, papillose, tuberculate or rarely smooth.

KEY TO THE GENERA

- A. Sori elongate along the margin, rachis and rachilets pubescent ..... *Pteridium*
- A. Sori not elongate along the margin, rachis and rachilets glabrous ..... *Hypolepis*

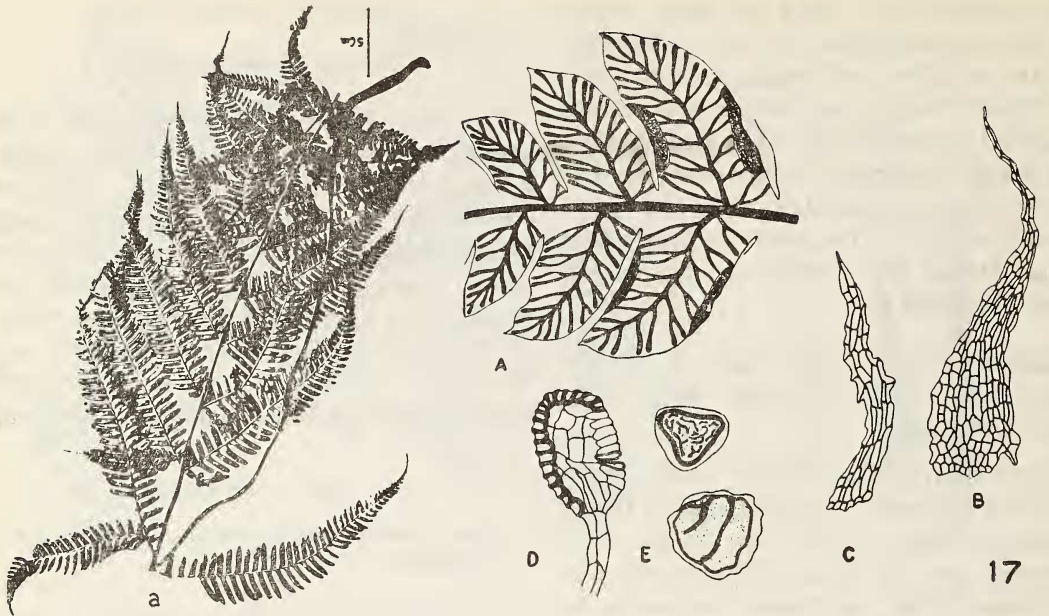
**Pteridium Scopoli**

Rhizome long-creeping, hypogaeous, solenostelic, clothed with hairs; fronds pinnately-compound, coriaceous, more or less densely hairy, veins free except for a marginal strand; sorus continuous along the margin, borne on the connecting vein, indusium double, the outer (false) one formed by the reflexed margin, the inner (true) one developed or obsolescent, paraphyses none, sporangium slender-stalked; spores tetrahedral or globose tetrahedral, smooth.

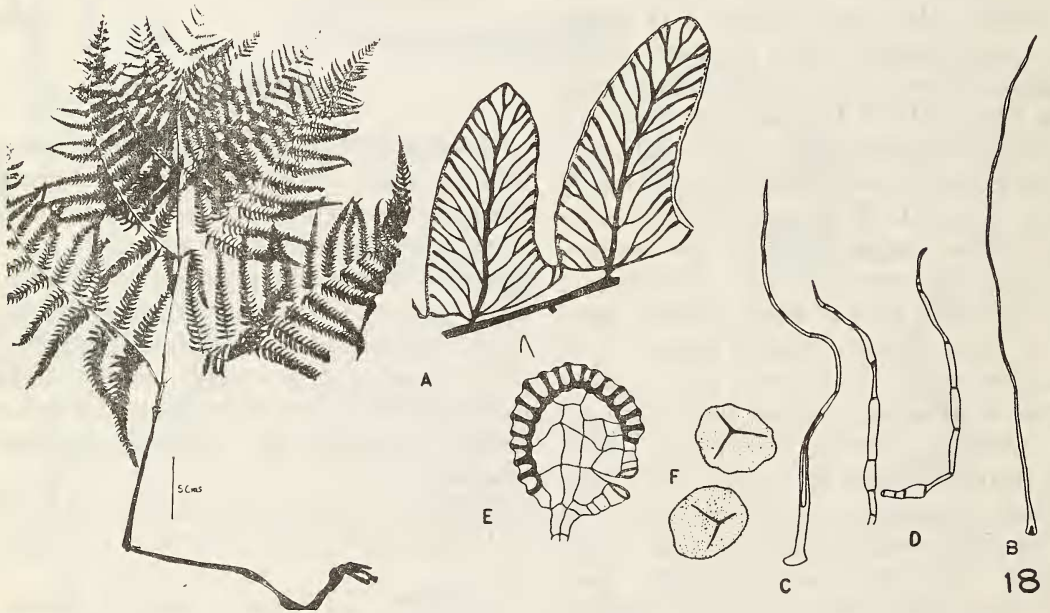
A monotypic genus distributed in the tropical and temperate regions of the world.

**P. aquilinum** (L.) Kuhn ex Decken, Reisen in Ost. Afrika, 3, 11, 1879; Mehra & Bir, Res. Bull. Panjab Univ. (N.S.), 15, 118, 1964.

Rhizome stout, creeping, hypogaeal, clothed with pale-brown, generally long, unicellular hairs; fronds rather distant; stipes 15-30 cm



17



18

Fig. 17. *Pteris quadriaurita*; a. A plant; A. Part of the pinnule, showing venation,  $\times c 4.2$ ; B. Rhizome scale,  $\times c 20.4$ ; C. Scale at the base of stipe,  $\times c 20.4$ ; D. Sporangium  $\times c 58.8$ ; E. Spores,  $\times 266$ .

Fig. 18. *Pteridium aquilinum*; a. A plant; A. Part of the pinnule showing venation and position of sori,  $\times c 1.6$ ; B, D. Rhizome hairs,  $\times c 11.6$ ; C. Hair on pinnules,  $\times c 11.6$ ; E. Sporangium,  $\times c 88.8$ ; F. Spores,  $\times 256.6$ .

long, strong, erect, grooved, naked; lamina 20-35 × 40-60 cm, deltoid, tripinnate; pinnae 10-35 × 5-20 cm, often long, distinctly stalked, opposite to sub-opposite, basal one is the longest, gradually reduced upward ending in an acuminate apex; pinnae at the apex simple, lanceolate; pinnae finely dissected into 10-20 lanceolate-acuminate, alternate, 6-12 × 0.8-2 cm pinnules; pinnules further dissected finely into 10-25, 0.7-1.5 × 0.3-0.5 cm segments; segments contiguous, more or less falcate, pubescent, narrowed more or less evenly from the dilated base to the rounded apex, cut almost or quite to the costa; rachis and rachilets distinct, yellowish-brown, sparsely hairy; hairs long, with cells placed end to end in a single row; texture coriaceous, yellowish-green in colour; venation indistinct, usually 6-12 veins on either side of costule; forked 1-3 times with a marginal commissure joining the apices of the veins; sori sub-marginal, linear, indusiate; indusium double, outer consisting of thin reflexed, edge of the pinnule, the inner thin attached just below the receptacle; sporangia with 18-20 celled annulus, globose, stalked; spores tetrahedral, pale-brown, minutely papillose, with a characteristic trilete marking, non-perisporiate (Fig. 18).

This species colonizes recently cleared places along streamlets. It is available near Dharamsala at an altitude of 1350 m.

### *Hypolepis* Bernh.

Rhizome creeping, solenostelic, clothed with usually reddish hairs; fronds mediocre to large, bipinnate or more compound, hairy or glabrous, herbaceous; veins free; sorus typically almost marginal and protected by a reflexed tooth, rarely inframarginal and naked, terminal on its vein; spores oblong, spinulose or tuberculate, rarely smooth.

Pantropic with more than 45 species, represented in the area by a single species.

*H. punctata* (Thunb.) Mett., Kuhn, Fil. Afr., 120, 1869; Bedd., Handb. Ferns Brit. India, Suppl., 19, 1892.

Rhizome slender, creeping, short-hairy, without scales; fronds distant, erect, pale-green, 100-126 cm long; stipes hairy upto 30-65 cm long; rachises and costa bearing short crisp hairs on both surfaces; lamina deltoid, deeply quadripinnatifid, the large lower pinnae opposite, the smaller upper pinnae alternate; largest pinnae 20-30 cm or more long, oblique to the main rachis, broadly deltoid, upper pinnae gradually more narrowly deltoid; basal pinnule of lowest pinnae 10-20 × 1-2.5 cm; oblique to pinna-rachis; largest leaflets of third order 1-1.5 × 0.3-0.6 cm, pinnate to a narrowly winged costa almost to the bluntly pointed apex; leaflets of fourth order lobed, apex rounded, usually with a sorus on the acroscopic margin of a lobe near the base of the sinus; sori terminal on a vein, usually covered or partly covered with a pale reflexed marginal flap, but sometimes quite exposed; sporangium with 16 celled annulus; spores oblong with minute projections on its surface (spinulose) (Fig. 19).

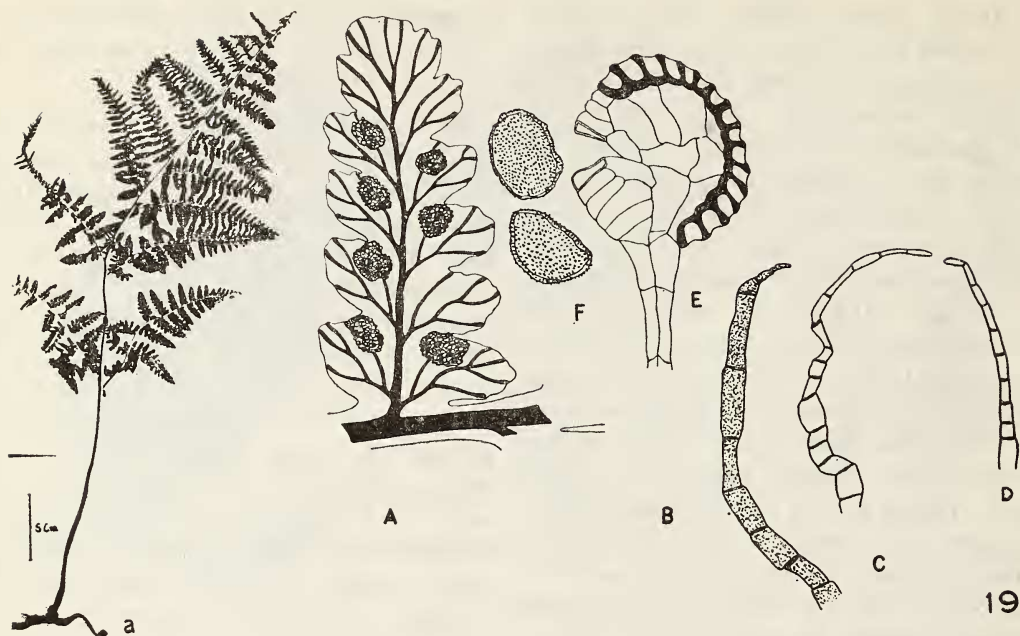
Very common near Khanjjar Mahan Dev Temple at 1700 m in exposed places.

### Family DAVALLIACEAE

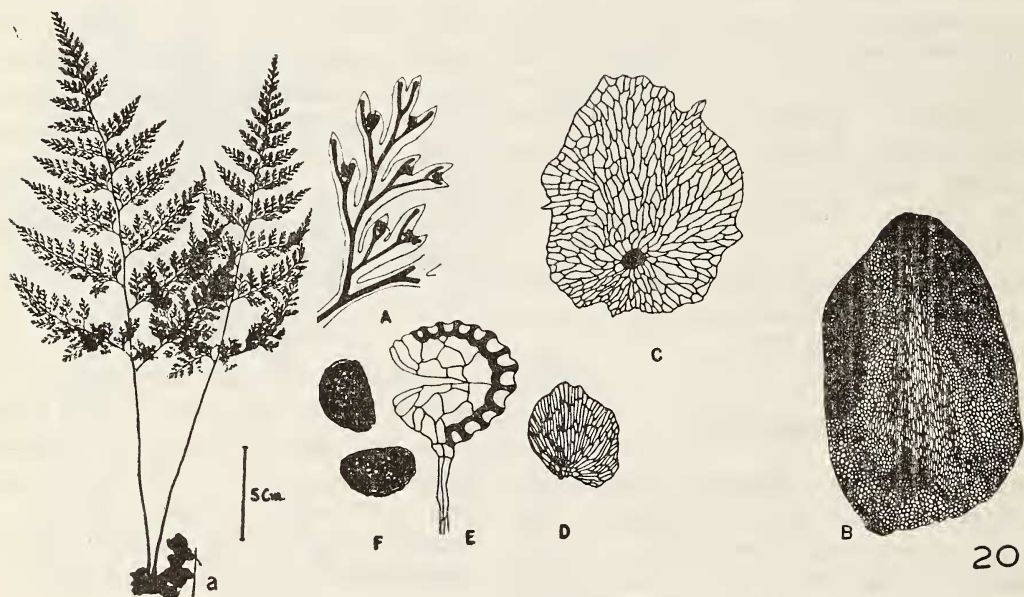
Epiphytes; rhizome wide-creeping, fleshy; covered with peltate scales; fronds membranaceous and flaccid, simple to decomponently pinnate; stipes smooth, jointed to the rhizome, each with several vascular strands (except *Leucostegia*), veins free, forked; sori intra or sub-marginal or dorsal on the frond, usually indusiate; spores bilateral.

### *Araiostegia* Copeland

Fronds large, pinnately-decompound and finely dissected, thin in texture, mostly lanceolate; sori sub-marginal, solitary at the ends of



19



20

Fig. 19. *Hypolepis punctata*; a. A plant; A. A part of pinna showing venation and position of sori,  $\times c 3.6$ ; B. Rhizome hair with brownish contents,  $\times c 17.6$ ; C, D. Rhizome hairs,  $\times c 17.6$ ; E. Sporangium,  $\times c 80$ ; F. spores,  $\times 231$ .

Fig. 20. *Araiostegia pseudocystopteris*; a. A plant; A. Part of the Pinna showing venation and position of sori,  $\times c 3.6$ ; B. Rhizome scale,  $\times c 10.4$ ; C. Stipe scale,  $\times c 17.6$ ; D. Indusium,  $\times c 17.6$ ; E. Sporangium,  $\times c 80$ ; F. Spores,  $\times 231$ .

single veins in a cup-like indusium attached on the side remote from the margin ; spores bilateral, oblong, granulated.

KEY TO THE SPECIES

- A. Lamina deltoid-oblong, 4-pinnate ; indusium more or less globose, margin wavy ; stipe scales ovate  
.....*A. pseudocystopteris*
  - A. Lamina deltoid, 5-6 pinnate ; indusium broader than long with entire margin ; stipe scales deciduous  
.....*A. delavayi*
- A. pseudocystopteris** (Kze.) Copel., Phil. Jour. Sci., 34, 241, 1927 ; Mehra & Bir, Res. Bull. Panjab Univ. (N.S.), 15, 119, 1964.

Rhizome 3-6 mm thick, woody, wide-creeping, epigeaeous, densely scaly ; scales 3-6 × 2.5-3 mm, golden-brown, ovate, persis-

tent ; fronds rather approximate ; stipe 6-10 cm long, sparsely scaly ; scales ovate, golden-brown like those of rhizome scales ; lamina deltoid-oblong, 7-28 cm long, 4.5-15 cm broad, 4-pinnate ; pinnae 3-12 jugate, patent, sessile, 2.5-9 × 2.5-4 cm ; ultimate pinnules pinnatifid with 2-4 small ligulate acute, uninerved segments, 1-2 mm long, 0.5 mm broad ; texture thin herbaceous, pale-green, glabrous ; sori small, situated at the forking of ultimate lobes ; indusium small, membranaceous, grey, persistent, more or less globose, sporangia with 13-celled annulus ; spores bilateral, granulated with thick exine (Fig. 20).

This species grows both as an epiphyte and on moist and humus rich rocks. Met with near Mcleodganj at 1200 m covering the branches of *Quercus incana* (oak).

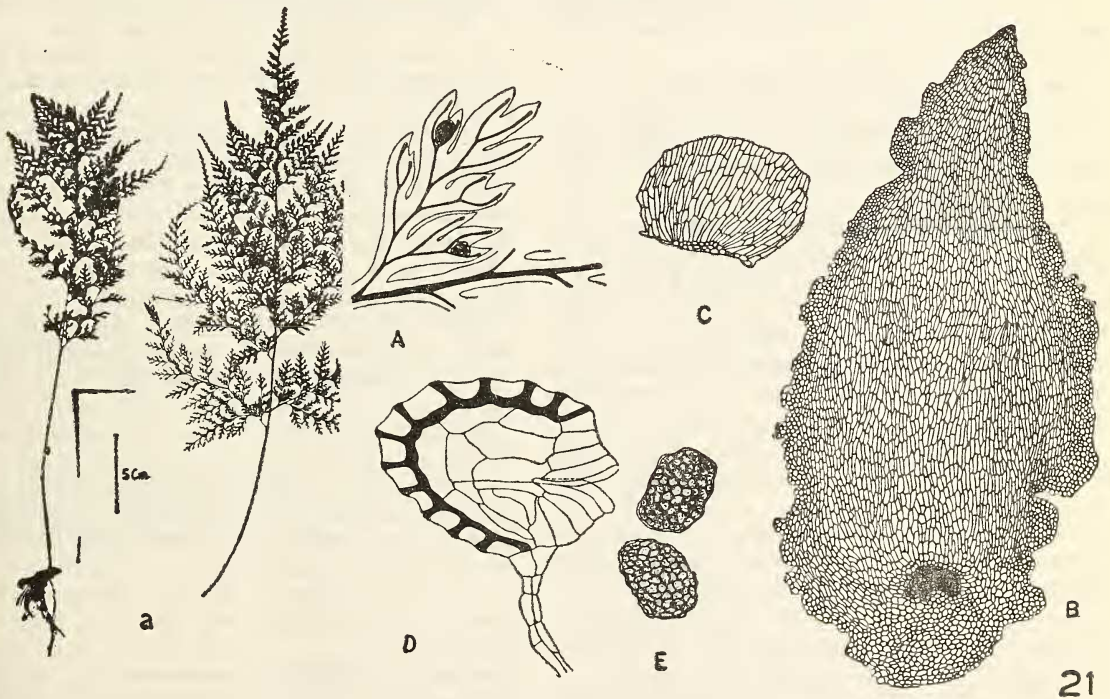


Fig. 21. *Araiostegia delavayi* ; a. A plant ; A. Part of lamina showing venation and position of sori, × c 4.4 ; B. Rhizome scale, × c 12.4 ; C. Indusium, × c 21.2 ; D. Sporangium, × c 61.2 ; E. Spores, × 277.2.

A. delavayi (Bedd. ex Clarke et Bak.) Ching in Chien et Chun, Fl. Reipubl. Pop Sin., 2, 289, 1959.

Rhizome 2-5 mm thick, woody, wide-creeping, epigaeous, densely scaly; scales dense, golden-brown, ovate, persistent; fronds rather approximate; stipes 4.5-6 cm long, sparsely covered with ovate, deciduous scales; lamina 33 × 25 cm, deltoid, 5-6 pinnate; pinnae stalked, basal pinnae largest, ultimate pinnules linear and pointed; rachis naked;

veins forked, slightly swollen at the tips; sori triangular (nearly cordate) present at the forking point of ultimate veinlets; texture herbaceous, pale-green, glabrous; indusium small, membranaceous, grey persistent, broader than long with entire margin; sporangia with 12-13 celled annulus; spores globose, granulated, exine thick (Fig. 21).

A common epiphyte near Mcleodganj and Dharmkot between 1700-2000 m.

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